REMARKS

Applicants gratefully acknowledge the Examiner's Interview with Examiner Graybill held on April 8, 2004 (see Examiner's Interview Summary, dated April 8, 2004), in which the submission of declaratory evidence was discussed.

Claims 17 and 19 have been amended. New claims 51-64 have been added. Specifically, claims 17 and 19 have been amended to recite that the bonding conditions include --conditions of 100-250°C temperature-- as supported by the original claims of Preliminary Amendment (A), filed on February 20, 2001, with the instant application. The claims were unnecessarily narrowed and the original claims distinguish over the prior art as discussed below.

New claim 51 recites subject matter similar to amended claim 17, except that the Markush group of claim 17 has been replaced with --epoxy resin and polyimide resin-- as supported on page 19, lines 14-18, of the present specification. New claims 52-57 recite limitations corresponding to those of claims 39-44, respectively.

New claim 58 recites subject matter analogous to amended claim 19, except that the Markush group of claim 19 has been replaced with --epoxy resin and polyimide resin-- as supported on page 19, lines 14-18, of the present specification. New claims 59-63 recite limitations corresponding to those of claims 39-44, respectively.

New claim 64 recites subject matter analogous to claim 30, except that the Markush group of claim 30 has been replaced with --epoxy resin and polyimide resin-- as supported on page 19, lines 14-18, of the present specification.

Applicants believe that the present amendment adds no new matter to the application. In view of the amendment, and for the following reasons, Applicants respectfully request that the present application be reconsidered and the claims allowed.

The Drawings

Applicants respectfully traverse the Examiner's objection to the drawings (Office Action, dated October 14, 2003, also referred to as the "October 14th Office Action," page 2, lines 1-9) for the following reasons. First, the drawings include Figures 1, 2 and 3 and completely satisfy the requirements of 37 C.F.R. 1.83(a). Second, the burden is on the Examiner to point out any defects in the drawings. The Examiner has not specifically pointed out any single specific defect that should be corrected. Third, Applicants point out that independent claims 17, 19 and 30 are each directed to an organic die-bonding film, such as shown in Figures 1(a)-1(e) as "filmy organic die-bonding material" (1) and in Figure 2 as "filmy organic die-bonding material" (22). No other drawings are required because, as stated in MPEP § 601.01(f), separate drawings are not required for articles made from a particular material or composition.

"Peel Strength" as used in the specification and claims is clearly defined in the specification

An applicant may act as his own lexicographer and ascribe a certain meaning to a claim term when the applicant's written description supports that meaning. Digital Biometrics Inc. v. Identix Inc., 1418, 1424 (Fed. Cir. 1998). In the present case, Applicants have specifically, clearly, and with definiteness, defined the meaning of "peel strength" as described by Figure 2 and page 33, lines 1-16, of the present application. Explicitly, Applicants have exercised their right to be there own lexicographers and have ascribed a certain meaning to "peel strength," and this meaning is supported by the Applicant's written description by Figure 2 and page 33, lines 1-16.

The Invention

The present invention according to claim 17 pertains broadly to a filmy material for a semiconductor device having a support member such as a lead frame to which a semiconductor die or chip is attached using the die-bonding material and encapsulated with resin. More particularly, one preferred embodiment in accordance with the present invention is an organic die bonding film having a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher (as specifically described and defined in the present application) when a semiconductor has been bonded to a support member with said film under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, wherein said film comprises an organic material selected from the group consisting of epoxy resin, silicon resin, acrylic resin and polyimide resin. Preferred embodiments of the invention are limited to an organic material comprising epoxy resin and polyimide resin.

A second embodiment in accordance with the present invention is an organic die-bonding single layer film having the property of bonding a semiconductor chip to a support member under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, and having a modulus of elasticity of 10 MPa or less at a temperature of 250°C, wherein the film comprises an organic material selected from the group consisting of epoxy resin, silicon resin, acrylic resin and polyimide resin.

A third embodiment in accordance with the present invention is an organic die-bonding film having the property of bonding a semiconductor chip to a support member under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, wherein the film has a water absorption of 1.5% by volume or less, a saturation moisture absorption of 1.0% by volume or less, a modulus of elasticity of 10 MPa or less at a temperature of 250°C, a void volume of 10% or less in terms of voids present in the film and at an interface between said film and a support member at a stage where a semiconductor has been bonded to a support

member by said film, a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher (as defined in the instant specification) at a stage where a semiconductor has been bonded to a support member with said film, and a residual volatile component in an amount of not more than 3.0% by weight, wherein the film comprises an organic material that includes epoxy resin and polyimide resin.

A fourth embodiment in accordance with the present invention is an organic die bonding film having a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher (as specifically described and defined in the present application) when a semiconductor has been bonded to a support member with said film under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, wherein said film comprises an organic material that includes epoxy resin and polyimide resin.

A fifth embodiment in accordance with the present invention is an organic die-bonding single layer film having the property of bonding a semiconductor chip to a support member under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, and having a modulus of elasticity of 10 MPa or less at a temperature of 250°C, wherein the film comprises an organic material that includes epoxy resin and polyimide resin.

A sixth embodiment in accordance with the present invention is an organic die-bonding film having the property of bonding a semiconductor chip to a support member under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, wherein the film has a water absorption of 1.5% by volume or less, a saturation moisture absorption of 1.0% by volume or less, a modulus of elasticity of 10 MPa or less at a temperature of 250°C, a void volume of 10% or less in terms of voids present in the film and at an interface between said film and a support member at a stage where a semiconductor has been bonded to a support member by said film, bonds with a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher at a stage where a semiconductor has been bonded to a support member with said film, and a

residual volatile component in an amount of not more than 3.0% by weight, wherein the film comprises an organic material that includes epoxy resin and polyimide resin.

All of the remaining dependent claims recite various other preferred embodiments. The advantages of the preferred embodiments of the film material in accordance with the present invention is that the film material allows for the manufacture of semiconductor devices that have fewer flow cracks and other defects that devices made with silver paste have because the material of the present invention is less prone to forming reflow cracks during the fabrication of semiconductor devices. Thus, devices made with the film material in accordance with the present invention can be reliably manufactured to have good durability that is an improvement over the prior art devices.

The Rejections

Claims 17-19, 21-34 and 37-50 stand rejected under 35 U.S.C. 112, first paragraph, for lacking an adequate written description and for lacking enablement. Claims 17-19, 21-34 and 37-50 also stand rejected under 35 U.S.C. 112, second paragraph, as indefinite.

Claims 17-19, 21-34, 37, 38 and 45-50 stand rejected under 35 U.S.C. 103(a) as unpatentable over Morita (U.S. Patent 5,406,124). Claims 31, 32, 40 and 42 stand rejected under 35 U.S.C. 103(a) as unpatentable over Morita in view of Berger (U.S. Patent 4,681,928). Claim 39 stands rejected under 35 U.S.C. 103(a) as unpatentable over Morita in view of both Berger (U.S. Patent 4,681,928) and Jackson (U.S. Patent 4,965,331). Claim 41 stands rejected under 35 U.S.C. 103(a) as unpatentable over the combination of Morita and Berger, and further in view of Baumann (U.S. Patent 5,296,567).

Applicants traverse the rejection and request reconsideration for the following reasons.

Applicants' Arguments

Rejections under 35 U.S.C. § 112, first paragraph, written description

In order to comply with 35 U.S.C. § 112, first paragraph, the description must clearly allow persons of ordinary skill in the art to recognize that the inventor invented what is claimed. Union Oil Co. v. Atlantic Richfield Co., 54 USPQ2d 1227, 1232 (Fed. Cir. 2000). There is a strong presumption that an originally filed claim satisfies the written description requirement of 35 U.S.C. 112. In re Wertheim, 191 USPQ 90, 98 (CCPA 1976). It is the Examiner's burden to present evidence or show reasons why persons skilled in the art would not recognize in the disclosure a description of the invention defined by the claims. Id. at 97.

The Examiner's position is that the present application does not provide a sufficient description of a representative number of species to show Applicants had possession of the claimed genus (Office Action, dated December 31, 2002, page 3, lines 33-41; Office Action, dated October 14, 2004, page 3, line 35, to page 4, line 2). Applicants disagree for the following reasons. In addition, Applicants note that the Examiner has not stated a single reason explaining why Applicants' disclosure of at least six distinct species would fail to show that Applicants did not have possession of the claimed genus including an organic material selected from the group consisting of epoxy resin, silicon resin, acrylic resin and polyimide resin of claims 17 and 19. There is no reason why the possession of the specific organic materials of epoxy resin and polyimide resin of claims 51-64 would not be clear to one of ordinary skill.

The Federal Circuit has ruled that every species in a genus need not be described in order to meet the written description requirement for the genus. University of California v. Eli Lilly and Co., 43 U.S.P.Q.2d 1398, 1405 (Fed. Cir. 1997). In fact, some courts have held disclosure of a single species, in some circumstances, can show possession of the genus. In re Herschler, 200 U.S.P.Q. 711, 718 (C.C.P.A. 1979). In order to support claims drawn to the

use of known chemical compounds in a manner auxiliary to the invention, the written description is only required to be so specific as to lead one having ordinary skill in the art to that class of compounds. Id.

In this case, the present specification describes no fewer than 6 different species that have been actually reduced to practice, as compiled in Table 1, on page 21 of the instant specification, wherein each species is distinguished from the other ones by the polyimide resin A through F used in its composition (See present specification, page 18, line 17, to page 19, line 12). Each of these polyimides A through F is described by the particular acid dianhydride with diamine used to polymerize them. The written description is clearly specific enough to lead one of ordinary skill in the art to the claimed epoxy, silicon, acrylic and polyimide compounds, and to the more specific genus of claims 51-64.

The question of whether a specification provides an adequate written description of the subject matter of the claims is an issue of fact. In re Alton, 37 U.S.P.Q.2d 1578, 1583 (Fed. Cir. 1996). A declaration offering either factual evidence or opinion testimony to explain why one of ordinary skill in the art would have understood the specification to describe the subject matter of the claims must be considered by the Examiner. Id.

Applicants submit a Declaration under 37 C.F.R. § 1.132 by Mr. Shigeki Katogi (hereafter, the Katogi Declaration), which is attached herewith, to provide factual evidence and expert opinion establishing that the description provided by the above captioned application would allow a person of ordinary skill in the art to recognize that the inventors had possession of the subject matter of the claims 17-19, 21-34 and 37-64.

Specifically, Mr. Katogi is a person of ordinary skill in the art of making adhesives for semiconductor packages (See Katogi Declaration, sections 1 and 2). Mr. Katogi states that the specific species embodiments provided by polyimide resins A through F, compiled in Table 1 of the instant application and as described on page 18, line 15, to page 21, line 20, of

the instant application, made clear to him that the inventors had possession of at least six different species of film material (Katogi Declaration, page 4, lines 19-22). Mr. Katogi also explained that, based on the disclosure of the present invention, he believes he could synthesize (without undue experimentation) and characterize additional filmy organic die-bonding materials that fall within the subject matter of the claims (Katogi Declaration, page 4, line 22, to page 5, line 23). Mr. Katogi concluded that, as a person of ordinary skill in the art, the disclosure of the above captioned application clearly allows him to recognize that the present inventors invented the subject matter claimed in claims 17-19, 21-34 and 37-64, which includes both the species described and the genus defined by the described species (Katogi Declaration, page 6, lines 1-10, and page 8, line 14, to page 9, line 2).

Because the Applicants have shown that the present specification adequately supports multiple claimed species as shown by the words, examples and tables describing various properties of the die-bonding films in illustrative Examples 1-7 in accordance with the present invention (specification, page 3, lines 20-25, page 11, line 14 to page 17, line 8, and page 18, line 15 to page 36, line 26), and in view of the factual and opinion evidence provided by the Katogi Declaration showing the inventors had possession of the claimed subject matter, the burden is now on the Examiner to provide evidence to show why one of ordinary skill in the art would doubt that Applicants had possession of the claimed subject matter at the time of filing. In other words, the burden is on the Examiner to provide some evidence, or logical and rational reasoning, to establish that six species are not enough to show possession of the claimed genus in the present case or withdraw the rejection under 35 U.S.C. § 112, first paragraph, for lack of an adequate written description.

Rejections under 35 U.S.C. § 112, first paragraph, enablement

The Examiner has previously stated for the record the following: "the specification, while being enabling for the species of disclosed Examples 1-7..." (Office Action dated December 31, 2002, page 4, lines 13-14, emphasis added), and Applicants argued that the subject matter of claims 39-44 corresponds to these species (Amendment (C) filed June 30, 2003, page 12, lines 10-12). Applicants assert that new claims 52-57 and 59-63 also correspond to the species of Examples 1-7 of the present application.

The Examiner presently appears to contend that claims 39-44, which depend indirectly upon claim 17, are not enabled because the "peel strength of 0.5 kgf/(5 mm x 5 mm chip)" is "repugnant to the art" (Office Action, dated October 14, 2003, page 4, lines 9-15). In the present case, Applicants have exerted their right to act as their own lexicographer and have specifically defined the meaning of "peel strength" as used in the claims in the written disclosure of the application.

A rejection based on the notion that a claim term is "repugnant to the art" appears to be an issue of claim precision or "definiteness," as would fall under 35 U.S.C. § 112, second paragraph, and not under 35 U.S.C. § 112, first paragraph. The term is not indefinite because it is clearly defined in the specification. Consequently, the Examiner's rejection under 35 U.S.C. § 112, first paragraph, cannot stand on the grounds that the Examiner believes the claim language to be "repugnant to the art."

The proper test for enablement is whether the specification teaches enough to those of ordinary skill in the art that they can make and use the invention without undue experimentation. Amgen Inc. v. Hoechst Marion Roussel, Inc., 65 U.S.P.Q.2d 1385, 1400 (Fed. Cir. 2003). The Examiner appears to be raising this issue when he states "a person skilled in the art could not make the film genus as a whole without undue experimentation" (Office Action, dated October 14, 2003, page 5, lines 13-15).

Enablement is a question of law, determined upon the weighing of many factors. In re Wands, 8 U.S.P.Q.2d 1400, 1404 (Fed. Cir. 1988). Factors to consider when determining whether a disclosure would require undue experimentation include (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims. Id.

The Examiner contends that the specification does not enable the claimed genus. (Office Action, dated October 14, 2003, page 4, lines 21-22). Applicants disagree for the following totality of reasons.

Analysis of the Wands Factors for Claims Reciting the Markush Group

Claims 17, 19 and 30 recite an organic die bonding film comprising an organic material selected from the Markush group that consists of "epoxy resin, silicone resin, acrylic resin and polyimide resin." An analysis of the Wands Factors for die bonding films made in accordance with claims 17, 19 and 30 follows.

Direction and Guidance from Specification

First, the present specification gives ample guidance regarding how to make and use the claimed invention as recited in claims 17, 19 and 30. Well-known and commercially available starting materials for making polyimides are listed on page 11, line 13, to page 16, line 20, of the present specification. The specification directs that a polyimide can be obtained by subjecting one or more known tetracarboxylic dianhydrides (i.e., chosen from the list on page 11, line 13, to page 14, line 14) and one or more known diamines (i.e., chosen from the list on page 14, line 15, to page 16, line 20) to condensation using methods

conventionally known in the art at a temperature of 80°C or below until a precursor polyamic acid is formed (specification, page 16, line 2, to page 17, line 4). The polyimide is obtained by dehydration ring closure of the polyamic acid using a well-known heat treatment process or a well-known chemical method.

The specification also gives guidance regarding four classes of epoxy resin (i.e., glycidyl ether type, glycidylamine type, glycidyl ester type, or acrylic type) that are suitable for use in the present invention (instant specification, page 17, lines 9-12). The specification gives guidance that the organic material for the film can be made mainly of silicone resin or acrylic resin (instant specification, page 3, lines 21-24).

Working Examples are Present

Second, at least six specific examples are provided in the disclosure to teach how to make and use an organic die bonding film using polyimides obtained as described above (specification, page 18, line 15, to page 20, line 21). Organic die bonding films, of the present invention, are distinguished from prior art films by a particular combination of one or more physical properties. For example, organic die bonding films in accordance with claim 17 may include a polyimide resin and have the following physical property: (a) a peel strength (as defined in the specification) of 0.5kgf/(5 mm x 5 mm chip) or higher when a semiconductor has been bonded to a support member with said film under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2. What constitutes a polyimide resin is described and defined in the present specification as discussed above.

On the other hand, organic die bonding films in accordance with claim 17 may include an epoxy resin and have the following physical property: (a) a peel strength (as defined in the specification) of 0.5kgf/(5 mm x 5 mm chip) or higher when a semiconductor has been bonded to a support member with said film under conditions of 100-250°C

temperature and pressure of 0.1-30 gf/mm^2. What constitutes an epoxy resin is described and defined in the present specification as discussed above.

Claim 17 also includes organic die bonding films that include a silicone resin and have the following property: (a) a peel strength (as defined in the specification) of 0.5kgf/(5 mm x 5 mm chip) or higher when a semiconductor has been bonded to a support member with said film under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2. While no working examples of organic die bonding films made with silicone resin are provided in the present application, silicone resins are so well characterized in the art that no working examples are necessary for enablement.

Claim 17 also includes organic die bonding films that include an acrylic resin and have the following property: (a) a peel strength (as defined in the specification) of 0.5kgf/(5 mm x 5 mm chip) or higher when a semiconductor has been bonded to a support member with said film under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2. While no working examples of organic die bonding films made with acrylic resin are provided in the present application, acrylic resins are so well characterized that no working examples are necessary for enablement.

Organic die-bonding films in accordance with claim 30 meet all of the limitations of die bonding films in accordance with claim 17, but they must also have the following additional physical properties: (b) a water absorption of 1.5% by volume or less, (c) a saturation moisture absorption of 1.0% by volume or less, (d) a modulus of elasticity of 10 MPa or less at a temperature of 250°C, (e) a void volume of 10% or less, and (f) a residual volatile component in an amount of not more than 3.0% by weight.

An organic die-bonding single layer film in accordance with claim 19 may include a polyimide resin and have the following physical properties: (a) the property of bonding a semiconductor chip to a support member under conditions of 100-250°C temperature and

pressure of 0.1-30 gf/mm^2, and (b) a modulus of elasticity of 10 MPa or less at a temperature of 250°C. The present specification describes in Table 7 at least three working die bonding films containing polyimide and epoxy resin that satisfy the claimed limitations of claim 19.

Nature of the Invention and State of the Art

Third, the present invention is directed to organic die bonding films that are relatively simple in composition and straightforward to make as evident from page 16, line 21, to page 20, line 20, of the instant specification. The State of the Art is mature as evident from the roughly 106 prior art references of record in the present case. In addition, the Morita Patent, which is the primary reference recited against the claims of the present application, was published almost 9 years ago in 1995 and further suggests the mature nature of the relevant art.

The Relative Skill of Those in the Art

Fourth, as evidenced by Sections 1 and 2 of the Masuko Declaration and by Sections 1 and 2 of the Katogi Declaration, persons of ordinary skill in the art of making adhesives for semiconductor packages are highly trained professionals with advanced degrees, who are involved in research and technological advancement of the field. The relative skill level of those in the art is high.

Predictability or Unpredictability of the Art

Fifth, Applicants have no data at present to make a direct claim as to the degree of predictability in the art.

Quantity of Experimentation Necessary

Sixth, the present specification generally outlines the method for making organic die bonding films in accordance with the present invention on page 16, line 21, to page 20, line 20, using materials listed on page 11, line 14, to page 16, line 20. Films made in accordance with these directions will require testing to determine if they include the properties recited in the claims. The various tests needed to determine if such films fall within the scope of the present invention as claimed are either generally well known tests, or specifically described and defined in the application, or amply described in the application and simple to perform (See instant specification, page 21, line 23, to page 36, line 24). Thus, Applicants assert that while some experimentation may be necessary, it is no more than is commonly encountered the art.

Breadth of Claims

Seventh, the breadth of claim 17 includes the 10 species embodiments disclosed in Table 5, on page 32. The breadth of claim 19 includes the 3 species embodiments disclosed in Table 7, on page 36. The breadth of claim 30 includes the 3 species embodiments disclosed in Table 7, which are also disclosed in Tables 1, 2 and 5. Each of claims 17, 19 and 30 cover, in scope, multiple working examples disclosed by the present specification. Those skilled in the art would realize that two or more species describe a genus. Because independent claims 17, 19 and 30 each encompass multiple working examples from the instant specification, Applicants believe that each independent claims 17, 19 and 30 enables a distinct genus falling within the scope of the present invention.

Summary of the Wands Factors

The above factors favor, as a matter of law, that Applicants application as originally filed would teach a person of ordinary skill in the art how to make and use the claimed invention without undue experimentation. Specifically, Applicants' application provides considerable direction and guidance on how to practice the invention, multiple working examples, there is a high level of skill in the art, and the methods and materials needed to practice the invention are well known. While the degree of predictability in practicing the invention is not known, it reasonably is less than in the biotechnological arts, which have been deemed enabled under similar circumstances. In re Wands, 8 U.S.P.Q.2d at 1406. Lastly, the breadth of each independent claim of the present invention covers, in scope, multiple specific species embodiments taught in the specification, which supports that the breadth of the claims is not overbroad.

Analysis of the Wands Factors for Claims Reciting Epoxy and Polyimide resins

Claims 51, 58 and 64 recite an organic die bonding film comprising an organic material that includes "epoxy resin and polyimide resin." An analysis of the Wands Factors for die bonding films made in accordance with claims 51, 58 and 64 follows.

Direction and Guidance from Specification

First, the present specification gives ample guidance regarding how to make and use the claimed invention as recited in claims 51, 58 and 64. Well-known and commercially available starting materials for making polyimides are listed on page 11, line 13, to page 16, line 20, of the present specification. The specification directs that a polyimide can be obtained by subjecting one or more known tetracarboxylic dianhydrides (i.e., chosen from the list on page 11, line 13, to page 14, line 14) and one or more known diamines (i.e., chosen

from the list on page 14, line 15, to page 16, line 20) to condensation using methods conventionally known in the art at a temperature of 80°C or below until a precursor polyamic acid is formed (specification, page 16, line 2, to page 17, line 4). The polyimide is obtained by dehydration ring closure of the polyamic acid using a well-known heat treatment process or a well-known chemical method.

The specification also gives guidance regarding four classes of epoxy resin (i.e., glycidyl ether type, glycidylamine type, glycidyl ester type, or acrylic type) that are suitable for use in the present invention (instant specification, page 17, lines 9-12). Such epoxy resins are so well characterized in the art that no specific examples are necessary.

Working Examples are Present

Second, at least six specific examples are provided in the disclosure to teach how to make and use an organic die bonding film using polyimides obtained as described above (specification, page 18, line 15, to page 20, line 21). Organic die bonding films, of the present invention, are distinguished from prior art films by a particular combination of one or more physical properties. For example, organic die bonding films in accordance with claim 51 must include a polyimide resin and an epoxy resin, and have the following physical property: (a) a peel strength (as defined in the specification) of 0.5kgf/(5 mm x 5 mm chip) or higher when a semiconductor has been bonded to a support member with said film under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2. What constitutes a polyimide resin is described and defined in the present specification as discussed above. Furthermore, what constitutes an epoxy resin is also described and defined in the present specification as discussed above.

Organic die-bonding films in accordance with claim 64 meet all of the limitations of die bonding films in accordance with claim 51, but they must also have the following

additional physical properties: (b) a water absorption of 1.5% by volume or less, (c) a saturation moisture absorption of 1.0% by volume or less, (d) a modulus of elasticity of 10 MPa or less at a temperature of 250°C, (e) a void volume of 10% or less, and (f) a residual volatile component in an amount of not more than 3.0% by weight.

An organic die-bonding single layer film in accordance with claim 58 must include a polyimide resin and epoxy resin, and have the following physical properties: (a) the property of bonding a semiconductor chip to a support member under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, and (b) a modulus of elasticity of 10 MPa or less at a temperature of 250°C. The present specification describes in Table 7 at least three working die bonding films containing polyimide and epoxy resin that satisfy the claimed limitations of claim 19.

Nature of the Invention and State of the Art

Third, the present invention is directed to organic die bonding films that are relatively simple in composition and straightforward to make as evident from page 16, line 21, to page 20, line 20, of the instant specification. The State of the Art is mature as evident from the roughly 106 prior art references of record in the present case. In addition, the Morita Patent, which is the primary reference recited against the claims of the present application, was published almost 9 years ago in 1995 and further suggests the mature nature of the relevant art.

The Relative Skill of Those in the Art

Fourth, as evidenced by Sections 1 and 2 of the Masuko Declaration and by Sections 1 and 2 of the Katogi Declaration, persons of ordinary skill in the art of making adhesives for semiconductor packages are highly trained professionals with advanced degrees, who are

involved in research and technological advancement of the field. The relative skill level of those in the art is high.

Predictability or Unpredictability of the Art

Fifth, Applicants have no data at present to make a direct claim as to the degree of predictability in the art. However, in In re Wands, 8 U.S.P.Q.2d at 1406, the Federal Circuit held that where there is considerable direction and guidance in the application on how to practice the invention, the presence of working examples, a high level of skill in the art, and the methods needed to practice the invention are well known, then the degree of predictability plays a minor role in determining enablement. In the present case, the degree of unpredictability in the art of chemically synthesizing adhesives for semiconductor packaging would be less than the degree of unpredictability in the art of synthesizing IgM immunoglobulins from immortal cell lines, such as was the technology of the Wands case.

The present application provides considerable direction and guidance on how to practice the invention, multiple working examples, there is a high level of skill in a mature art, and all of the methods and materials needed to practice the invention are well known. In view of these facts and the likelihood that chemical synthesis is more predictable than technologies such as those producing anti-bodies from cell lines, any unpredictability in the present art would not reasonably overwhelm those other factors that lend to the conclusion that undue experimentation in not necessary in the practice of the present invention.

Quantity of Experimentation Necessary

Sixth, the present specification generally outlines the method for making organic die bonding films in accordance with the present invention on page 16, line 21, to page 20, line 20, using materials listed on page 11, line 14, to page 16, line 20. Films made in accordance

with these directions will require testing to determine if they include the properties recited in the claims. The various tests needed to determine if such films fall within the scope of the present invention as claimed are either generally well known tests, or specifically described and defined in the application, or amply described in the application and simple to perform (See instant specification, page 21, line 23, to page 36, line 24). Thus, Applicants assert that while some experimentation may be necessary, it is no more than is commonly encountered the art.

Breadth of Claims

Seventh, the breadth of claim 51 includes the 10 species embodiments disclosed in Table 5, on page 32. The breadth of claim 58 includes the 3 species embodiments disclosed in Table 7, on page 36. The breadth of claim 64 includes the 3 species embodiments disclosed in Table 7, which are also disclosed in Tables 1, 2 and 5. Each of claims 51, 58 and 64 cover, in scope, multiple working examples disclosed by the present specification. Those skilled in the art would realize that two or more species describe a genus. Because independent claims 51, 58 and 64 each encompass multiple working examples from the instant specification, Applicants believe that each independent claim 51, 58 and 64 enables a distinct genus falling within the scope of the present invention.

Summary of the Wands Factors

The above factors favor, as a matter of law, that Applicants application as originally filed would teach a person of ordinary skill in the art how to make and use the claimed inventions of claims 51, 58 and 64 without undue experimentation. Specifically, Applicants' application provides considerable direction and guidance on how to practice the invention, multiple working examples, there is a high level of skill in the art, and the methods and

materials needed to practice the invention are well known. While the degree of predictability in practicing the invention is not known, it reasonably is less than in the biotechnological arts, which have been deemed enabled under similar circumstances. In re Wands, 8 U.S.P.Q.2d at 1406. Lastly, the breadth of each independent claim of the present invention covers, in scope, multiple specific species embodiments taught in the specification, which supports that the breadth of the claims is not overbroad.

Rejections under 35 U.S.C. 112, second paragraph

Applicants assert claims 17-19, 21-34 and 39-64 are in compliance with 35 U.S.C. 112, second paragraph.

The courts have held that for a claim to comply with 35 U.S.C. 112, second paragraph, it must (1) set forth what the applicant regards as his invention, and (2) it must do so with sufficient particularity and distinctness to be definite. Solomon v. Kimberly-Clark Corp., 55 U.S.P.Q.2d 1279, 1282 (Fed. Cir. 2000). The definiteness of the claim language must be analyzed in light of the teachings of the prior art and of applicant's disclosure as it would be interpreted by one possessing ordinary skill in the pertinent art. Id. When applicant has claimed what he regards as his invention, a rejection under 35 U.S.C. 112, second paragraph, must be justified on the grounds that the language used is not precise and definite enough to indicate the scope of the claim, or the language is so broad that it causes the claim to have a scope of protection beyond that which is justified by the applicant's disclosure. In re Swinehart, 169 U.S.P.Q. 226, 229 (CCPA 1971).

The Examiner asserts that the issue is that the limitation of "a peel strength of 0.5 kgf/(5 mm x 5 mm chip)," as recited in claims 17 and 30, is indefinite (Office Action, dated October 14, 2003, page 6, lines 12-17). As an initial matter, Applicants point out that this limitation is not included in claims 18, 19, 21, 22 and 58-63, and the Examiner has offered

no other reason for such claims being indefinite. Therefore, the Examiner's indefiniteness rejection of claims 18, 19, 21, 22 and 58-63 is untenable and should be withdrawn.

Regarding claims 17, 23-34, 37-44, 47-57 and 64, Applicants assert that these claims are in compliance with 35 U.S.C. § 112, second paragraph, for the following reasons.

1. Claim language is definite

Specifically, claim 17 of the present invention recites

> "[a]n organic die bonding film having a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher when a semiconductor has been bonded to a support member with said film under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, wherein said film comprises an organic material selected from the group consisting of epoxy resin, silicone resin, acrylic resin and polyimide resin."

In the present case, the invention is an organic die bonding film having a "peel strength" as specifically defined in the present specification (page 33, lines 1-16), and the bond is further described by the language "when a semiconductor has been bonded to a support member **with said film** under conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2." Thus, the language of independent claims 17 and 30 reasonably describes a bond formed by the organic die bonding film, and that the film performs the bonding with a "peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher." Therefore, the "peel strength" is clearly a property of the film when providing a bond, as recited by these claims, where the meaning of "peel strength" is definite in view of the defined meaning ascribed to this term by Figure 2 and page 33, lines 1-16, of the above-captioned application.

The Examiner appears to contend that the claims are also indefinite because the units of peel strength should be limited to "mass to length" (Office Action, October 14, 2003, page 6, lines 12-17). Applicants assert that the Examiner's asserted limitation is unnecessary and that others in the art have correctly used units of mass-force to area as a measure of peel strength. Specifically, the "Standard Test Method for Peel or Stripping Strength of Adhesive

Bonds" (of record) teaches ASTM Designation: D 903-98, which is measured in units of "kilograms per millimetre...of width" (page 1, section 3.2.2). Applicants believe that persons of ordinary skill in the art would recognize that this standard reports values in units of mass-force to area.

Likewise, the Morita reference reasonably describes measurement of peel strength in units of mass-force to area. Specifically, Morita describes that the test pieces are 10 mm x 10 mm squares and then reports peel strength as "grams" (see col. 17, lines 13-21, and the Table of the Morita reference). Applicants believe that a person skilled in the art would recognize that the units for measuring peel strength in the Morita reference are grams to (10 mm x 10 mm) piece, which is a unit of mass-force to area. Even the Examiner recognizes these units when he states that "the prior ort (sic) of Morita closest to the claimed peel strength includes a peel strength of 67g/mm^2 chip" (Office Action, dated October 14, 2003, page 21, lines 9-10).

In summary, it is evident that the prior art references and standards may use units of mass-force to area to report peel strength values. Even if this were not the case, the present application unambiguously defines "peel strength," as used in the present specification and claims, and how that "peel strength" is measured and expressed.

The arguments applied to claim 17 also apply to claim 30.

2. Claim language is not "repugnant to the art."

Courts have held that there is no requirement for the claims of a new invention to speak in the language of the prior art so long as any new expressions in the claims are definite. In re Fisher, 166 U.S.P.Q. 18, 23 (C.C.P.A. 1970). As the law permits, an applicant may act as his own lexicographer and ascribe a certain meaning to a claim term when the applicant's

written description supports that meaning. Digital Biometrics Inc. v. Identix Inc., 1418, 1424 (Fed. Cir. 1998).

Whether reciting a "peel strength of 0.5 kgf/(5 mm x 5 mm chip)" would be "repugnant to the art" as the Examiner suggests (Office Action, dated October 14, 2003, page 4, lines 9-15) is an issue relating to 35 U.S.C. § 112, second paragraph, and not 35 U.S.C. § 112, first paragraph. As previously explained, the prior art reasonably supports that it is conventional to report peel strength in units of mass-force to area. For this reason alone, the phrase "peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher," which is recited in claims 17, 30, 51 and 64, would not be "repugnant to the art."

Even if such mass-force to area units of peel strength measurement were considered unconventional, Applicants' disclosure plainly states that "peel strength refers to the peel strength of the filmy organic die-bonding material at the stage where the semiconductor chip is bonded to the support member through the filmy organic die-bonding material" (Applicants' specification, page 31, lines 8-11), and describes in detail how peel strength was measured for the purposes of the present invention (Applicants' specification, page 33, lines 1-16, and figure 2). Figure 2 of the present application illustrates that a push-pull gauge applies the test force at an angle of 17 degrees from the planar surface of the test chip.

Mr. Masuko, one of the co-inventors, stated in the Second Masuko Declaration that the peel strength test described in the present application was developed specifically for this application for the purpose of providing a more efficient test for testing the detrimental effects of reflow cracking (Second Masuko Declaration, page 9, line 21 to page 10, line 16). Specifically, Mr. Masuko stated that the peel strength test disclosed in the present application was developed to apply a test force diagonally at an angle of 17-degrees to the plane of the adhesive film in order to simultaneously evaluate both linear areal peel strength and shear peel strength adhesive properties of the organic die-boning films of the present invention

(Second Masuko Declaration, page 9, lines 9-20). Mr. Masuko stated that, in his opinion, a person of ordinary skill in the art would realize that the peel strength test defined in the present application is a 17-degree peel strength test (Second Masuko Declaration, page 8, lines 5-10). Mr. Masuko stated that he knew of no conversion factor that could be used to convert peel strength values obtained using the 17-degree peel strength test, described in the present application, to 90-degree peel strength values obtained using a 90-degree peel strength test because he did not believe there was a linear relationship between linear and shear adhesive peel strength properties (Second Masuko Declaration, page 9, lines 13-20).

In addition, Mr. Katogi, a researcher at Hitachi Chemical Company, Ltd. but not one of the co-inventors of the present application, stated in the Katogi Declaration that he recognized from the disclosure of the present application the description of a "17-degree peel strength" test (Katogi Declaration, page 6, line 14, to page 8, line 6). Mr. Katogi states that 90-degree peel strength tests apply a test force at an angle of 90° to the plane of the adhesive and that 180-degree peel strength tests apply a test force at an angle of 180° to the plane containing the adhesive (Katogi Declaration, page 7, lines 10-22). In Mr. Katogi's opinion, the "peel strength" test disclosed in Figure 2, and on page 33, lines 1-16, of the present application would be recognized by those skilled in the art as a 17-degree peel strength test in accordance with the custom of the industry (Katogi Declaration, page 6, line 14, to page 8, line 6).

As the law permits, the present inventors have acted as their own lexicographer by ascribing a certain meaning to the claim term "peel strength" as supported by the written description of the originally filed application. Specifically, "peel strength" in accordance with the present invention means "peel strength" as fully described and defined by Figure 2 and page 33, lines 1-16, of the present application.

Rejections under 35 U.S.C. 103

The Morita reference discloses an "insulating adhesive tape," that includes a base supporting film and an adhesive layer formed on at least one surface thereof (see Abstract). As shown in Figure 4, the adhesive tape includes base supporting film (41) and two adhesive layers (42) and (43). Each adhesive layer (42), (43) is a thermoplastic polymer comprising a thermoplastic polyimide, wherein the polymer has a glass transition temperature ranging from 180°C to 280°C and an elastic modulus ranging from 10^{10} dyne/cm^2 to 10^{11} dyne/cm^2 at 25°C, wherein the elastic modulus includes a value ranging from 10^2 dyne/cm^2 to 10^9 dyne/cm^2 at a temperature between 250°C and 300°C. The Morita reference discloses that the thermoplastic polymer has a water absorbing ratio of less than 1.2% (col. 9, lines 14-16); however, Morita does not explicitly state to what the percentage relates. Specifically, the Morita reference only describes % by weight (col. 9, lines 35-39 and lines 53-55); therefore, it is suggested that Morita describes that the water absorbing ratio is less than 1.2% by weight. There is nothing in the Morita et al. reference to teach, or even suggest, that the water absorption is 1.5% by volume or less.

No Single Layer Structure

The Morita reference clearly discloses a three layer tape (4). The Morita reference does not teach, or even suggest, an "organic die-bonding single layer film" having the features recited in claims 19 and 58. The Examiner asserts that Morita does teach a single layer film (Office Action, page 9, line 4); however, the Examiner has not shown where in the Morita reference there is a teaching, or even a suggestion, that the three layered tape (4) shown in Figure 3 of Morita would be a "single layer film" as recited in claims 19 and 58 of the present application. When an examiner asserts there is either an explicit or implicit teaching in the prior art, the courts require the examiner to indicate where in the reference

this explicit or implicit teaching appears. In re Rijckaert, 28 U.S.P.Q.2d 1955, 1957 (Fed. Cir. 1993). In the present case, the Examiner has not met his burden of indicating where in the Morita reference there is a teaching, explicit or otherwise, that the "tape" (4) would be a "single layered film." Thus, the 103 rejection against claims 19 and 58 must be reconsidered and withdrawn.

Bonding Conditions: temperature and pressure combination

The combinations of temperature and pressure that provide the bonding conditions recited in claims 17, 19, 30, 51, 58 and 64 of the present invention are neither disclosed nor obvious in view of Morita.

The Morita reference discloses that the adhesive temperature for bonding IC chips to lead frames using the adhesive tape is selected from the range of 250-450°C (preferably 270-400°C) and the adhesive pressure is 1-50 kg/cm^2 (preferably 5-30 kg/cm^2), (col. 14, lines 3-14). However, the present invention has the advantage that die bonding can be carried out, in general, at significantly lower temperatures and pressures than the prior art. The present claims recite "conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2" in independent claims 17, 19, 30, 51, 58 and 64. As the Morita et al. reference does not teach, or even suggest, a bonding temperature of less than 250°C, Morita et al. can not anticipate the recited temperature range 100-250°C in combination with a pressure of 0.1-30 gf/mm^2 for the purposes of adhesive bond formation.

Peel Strength

The Morita reference does not disclose "a peel strength of 0.5 Kgf/5mm x 5mm chip or higher " as defined in the present specification and as recited in independent claims 17, 30, 51 and 64. The Examiner admits that "Morita does not appear to literally teach that the film

has a peel strength of 0.5 Kgf/5mm x 5mm chip or higher" (Office Action, dated October 14, 2003, page 13, lines 13-15). The Examiner asserts that, in the absence of unexpected results, it would be a matter of "design choice...ascertainable by routine experimentation and optimization" to arrive at the claimed peel strength range (Office Action, dated October 14, 2003, page 13, line 21 to page 14, line 6).

The Examiner's conclusion is untenable for the following reason. First, Morita teaches measuring 90-degree peel strength (col. 18, lines 3-10). The peel strength recited in the claims 17, 30, 51 and 64 is a "peel strength" as specifically defined in the present specification, a 17-degree peel strength. As established by the Masuko Declaration, section 10, and by the Katogi Declaration, section 6, 90-degree peel strength is a test of linear areal adhesive strength that is not directly comparable to peel strength as defined in the present specification, which is a test of the combined properties of adhesive linear areal strength and adhesive shear strength. In other words, Morita only teaches values for adhesive linear areal peel strength and is completely silent with respect to the adhesive shear strength properties of its films. On the other hand, claims 17, 30, 51 and 64 of the present application recite peel strengths that are specifically defined in the present specification, which reflect the combined adhesive effect of shear strength and linear areal strength properties of the films.

Morita cannot anticipate, or even suggest, the presently claimed "peel strength" values because the 90-degree peel strength test taught by Morita, by definition, cannot reflect adhesive shear strength. Therefore, Morita cannot be used to reasonably infer anything about the claimed peel strength properties of the present invention because Morita teaches nothing about adhesive shear strength. In other words, it is not possible to optimize the 90-degree peel strength properties of Morita's films to arrive at the peel strength properties (as clearly defined by the present specification) of the organic die-bonding films recited in independent claims 17, 30, 51 and 64.

Result Effective Variables

The Examiner argues that the following are "result-effective variables:" (a) water absorption (October 14th Office Action, page 11, lines 6-8), (b) void volume (October 14th Office Action, page 13, lines 3-5), and bonding temperature (October 14th Office Action, page 14, lines 7-17). While Applicants agree that bonding temperature is a result effective variable, Applicants disagree that water absorption and void volume are result effective variables. The Examiner's conclusion that water absorption and void volume are result effective variables is an error, as a matter of law, for the following reasons.

A result effective variable is a variable that effects the result of a process as demonstrated in In re Aller, 105 U.S.P.Q. 233, 234-235 (C.C.P.A. 1955). In Aller, 105 U.S.P.Q. at 234, the invention was a process for producing carbolic acid that varied from the prior art by using lower reaction temperatures and higher sulphuric acid conditions. In Aller, 105 U.S.P.Q. at 234, the court noted the fact that varying the temperature (i.e., a variable in the reaction process) had an effect on the production of phenol, carbolic acid (i.e., the result), and the issue decided by the court included whether a change in reaction temperature would have been obvious to one skilled in the art. The court in Aller, 105 U.S.P.Q. at 235, ruled that variation in temperature of a reaction process would be an unpatentable modification over the prior art in the absence of a new and unexpected result. It is notable that the court considered reaction temperature to be a result effective variable while the yield of phenol was addressed as the result. In re Aller, 105 U.S.P.Q. at 235.

By analogy to Aller, the reaction process utilized in the present invention is a die bonding reaction process, which includes temperature as a result effective variable. Varying the temperature of the die bonding process will effect the result, which is the state of the organic die bonding material that forms a die bond. The state of the organic die bonding material is described in terms of the properties of the die bonding material (i.e., water

absorption, void volume, etc.). In other words, while the die bonding temperature is a result effective variable, the water absorption and void volume properties of the die bonding material are the results. Consequently, as a matter of law, the Examiner is incorrect when he concludes that it would be obvious to optimize water absorption and void volume properties of the organic die bonding film recited in claims 30 and 64.

Another way to understand the Examiner's error is to look at the presently claimed invention and the pertinent inventions of the caselaw recited by the Examiner (October 14th Office Action, page 12, lines 4-8). The presently claimed invention is directed to an organic die bonding film, such as recited in claims 30 and 64, which is an article of manufacture or a composition of matter. The organic die bonding film of the presently claimed invention is not a method or a process. Compare Aller, 105 U.S.P.Q. at 234, where the invention was a process for producing carbolic acid, or In re Kulling, 14 U.S.P.Q.2d 1056, 1056 (Fed. Cir. 1990), directed to a claimed process for the treatment of a dilute iron (II) sulfate-containing sulfuric acid solution. Concisely stated, it is an error, as a matter of law, to apply rules directed to result effective variables to properties of a material.

Lastly, Applicants note the Examiner cited In re Hoeschele, 160 U.S.P.Q. 809 (C.C.P.A. 1969), which is directed to the unpatentability of certain polyurethane elastomers, and Merck & Co. Inc. v. Biocraft Laboratories Inc., 10 U.S.P.Q.2d 1843 (Fed. Cir. 1989), which is directed to the obviousness of a diuretic composition containing two known diuretics, amiloride hydrochoride and hydrochlorothiazide. Neither of these cases fairly stand for the proposition that properties of a material are result effective variables. In fact, the Examiner has not stated what propositions these cases stand for or how these two cases are even relevant to the present prosecution.

In summary, the Examiner has erroneously applied a rule directed to result effective variables pertaining to method claims to a claimed article of manufacture or composition of

matter. As a matter of law, the Examiner's conclusion that the "void volume of 10% or less" and the "water absorption of 1.5% by volume or less," which are properties of the organic die bonding film recited in claims 30 and 64, would be obvious is untenable and must be withdrawn.

Combinations of the Prior Art

The courts have held that to reject claimed subject matter in view of a combination of prior art references, a proper analysis under 35 U.S.C. § 103 must show that (a) the prior art would have suggested to those of ordinary skill in the art that they should make the claimed composition or device, (b) the prior art reveals that in so making, one of ordinary skill would have a reasonable expectation of success, and (c) both the suggestion and the reasonable expectation of success is found in the prior art and not in applicant's disclosure. In re Vaeck, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991).

The Berger Reference

The Berger reference discloses a "poly(amide-amide acid), polyamide acid, poly(esteramide acid), poly(amide-imide), polyimide, poly(esterimide) from poly arylene diamine." More particularly, Berger teaches reacting aromatic or aliphatic dianhydrides and/or acid anhydrides with certain aromatic diamines alone or in combination with other diamines to produce various compounds to include poly(amide-amide acid), polyamide acid, poly(esteramide acid), poly(amide-imide), polyimide, poly(esterimide), (See Abstract). Berger provides a long list of dianhydrides, such as 1,2-ethylene-bis-(trimellitate)anhydride, (col. 4, lines 10-58) that can be reacted with various diamines, which includes 4,4'-diaminodiphenyl ether (col. 11, line 27 to col. 12, line 2), and suggests that various

compounds could be synthesized by picking and choosing one of the dianhydrides and one of the diamines (col. 13, lines 55-68).

The Examiner is in error when he states "Berger teaches a polyimide synthesized from 4, 4'-diaminodiphenyl ether and 2, 2-bis[4-(4-aminophenoxy)phenyl]propane in combination with the dianhydride 1, 2-(ethylene)bis(trimellitate anhydride)" (October 14th Office Action, page 16, lines 2-5).

Specifically, the courts have ruled that in order to teach a particular compound a reference must clearly and unequivocally disclose the claimed compound without any need for picking, choosing, or otherwise combining various disclosures within the reference that are not directly related to one another. In re Arkley, 172 U.S.P.Q. 524, 526-527 (C.C.P.A. 1972). In other words, a reference that may suggest making a particular compound by picking and choosing from various options does not actually teach the compound. Id. This distinction is important in the present case because the Applicants are not claiming a particular polyimide; rather, what is claimed is an organic die bonding film that includes a particular polyimide.

Whether or not the particular polyimide recited in claim 40 would be obvious is a question of law under 35 U.S.C. § 103, but this is not the issue before the Examiner. The issue before the Examiner is whether it would be obvious for an organic die bonding film having the claimed properties, recited in claim 40, to include the claimed polyimide. Since Berger does not actually teach the polyimide recited in claim 40, Berger cannot reasonably teach, or suggest, the use of such a polyimide in a die bonding film. In other words, even if one were to conclude Berger suggests making the polyimide recited in claim 40 (a conclusion that Applicants assert has not been established as a matter of law), this conclusion would be insufficient to teach, or even suggest, that such a polyimide would be suitable for use in making adhesive die bonding films.

Thus, even if the Examiner could establish that it would have been obvious to make the polyimide recited in claim 40 using the teachings of the Berger reference, which he cannot, this legal conclusion would be insufficient to teach, or suggest, applying this polyimide to the films taught by Morita. Furthermore, the Berger reference is completely silent with respect to adhesive bond formation under "conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2" as recited in claims 17, 19 and 30, and the claimed characteristics of peel strength recited in claims 17 and 30, and claimed saturation moisture absorption recited in claims 18, 26 and 28-30.

The Jackson Reference

The Jackson reference discloses "curable resin compositions" that comprise a (bis- or poly-)-maleimide and a propargyl ether (See Abstract). Jackson teaches making maleimides by reacting maleic anhydride with a diamine, such as bis(4-amino-3,5-dimethylphenyl) methane (col. 2, lines 41-60). The Jackson reference does not teach that bis(4-amino-3,5-dimethylphenyl) methane is suitable for reacting with a dianhydride such as 1, 2-(ethylene)bis(trimellitate anhydride). Therefore, the Examiner has not shown there is a suggestion grounded in the prior art, and not Applicants' disclosure, to justify combining the diamine, bis(4-amino-3,5-dimethylphenyl) methane, with the teachings of the Morita and Berger references.

Furthermore, the Jackson reference is completely silent with respect to adhesive bond formation under "conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2" as recited in claims 17, 19 and 30, and the claimed characteristics of peel strength recited in claims 17 and 30, and claimed saturation moisture absorption recited in claims 18, 26 and 28-30.

The Baumann Reference

The Baumann et al. reference discloses "thermocurable compositions" based on at least one cationically polymerisable organic material and an initiator for cationic polymerisation in the form of an onium compound or a compound of the formula $[M^{+n}(L)_x]^{n+}nX^{--}$ (col. 1, lines 4-30). Baumann teaches making these compounds with diamine side groups such as bis(4-amino-3,5-diisopropylphenylphenyl) methane (col. 5, lines 1-9). The Baumann reference does not teach that bis(4-amino-3,5-diisopropylphenylphenyl) methane is suitable for reacting with a dianhydride such as 1, 2-(ethylene)bis(trimellitate anhydride). Therefore, the Examiner has not shown there is a suggestion grounded in the prior art, and not Applicants' disclosure, to justify combining the diamine, bis(4-amino-3,5-diisopropylphenylphenyl) methane, with the teachings of the Morita and Berger references.

Furthermore, the Baumann reference is completely silent with respect to adhesive bond formation under "conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2" as recited in claims 17, 19 and 30, and the claimed characteristics of peel strength recited in claims 17 and 30, and claimed saturation moisture absorption recited in claims 18, 26 and 28-30.

In summary, any combination of the Morita et al. reference, the Berger reference, the Jackson reference, and the Baumann et al. reference would not teach, or even suggest, an "organic die-bonding film" having the "a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher when a semiconductor has been bonded to a support member with said film under conditions of 100-230°C temperature and pressure of 0.1-30 gf/mm^2" as recited in claims 17 and 30. Furthermore, any combination of the Morita et al. reference, the Berger reference, the Jackson reference, and the Baumann et al. reference would not teach, or even suggest, an "organic die-bonding single layer film" having the features recited in claim 19.

Saturation Moisture Absorption

The Examiner's rejection of claims 18 and 26-34 is untenable and should be withdrawn because each of these claims recites a "saturation moisture absorption of 1% by volume or less," and the Examiner has made no argument that this limitation is taught by any of the prior art references. Specifically, the Examiner has only addressed the recited property of "water absorption" (October 14th Office Action, page 10, line 19 to page 11, line 5). The Examiner has not addressed "saturation moisture absorption," which is a different limitation from "water absorption" as evident from the instant specification (page 22, lines 5-9, and page 25, lines 2-7). Claim 30, which recites both of these features, is additional evidence that these features are different.

Applicants believe that a person of ordinary skill in the art would realize that water absorption and saturation moisture absorption are different properties of a material. For example, a sponge can have a high water absorption because it can absorb a lot of water, but it does not necessarily have a high saturation moisture absorption if it remains dry at a particular temperature and humidity.

Residual Volatile Component

The Examiner's rejection of claims 21, 22, 25 and 30 is untenable and should be withdrawn because each of these claims recites a "residual volatile component in an amount of not more than 3.0 % by weight," and the Examiner has made no argument that this limitation is taught by any of the prior art references. The present specification defines "residual volatile component" on page 27, line 22 to page 28, line 2, and this feature is not limited to the amount of residual solvent. Morita teaches that, after drying, the amount of solvent contained within the thermoplastic polymer layer is not more than 15% by weight

(col. 9, lines 53-59). However, the "residual volatile component" of films recited in claims 21, 22, 25 and 30 is not limited to solvent residues.

Applicants believe that a person skilled in the art, reading the definition of residual volatile component defined on page 27, line 22 to page 28, line 2, of the present specification, would realize that all volatile substances removed by heating are reflected in the present definition of residual volatile component. In other words, the solvents used would make up only a portion of the volatile component. Other volatile substances, such as water, would be included in the residual volatile component defined in the present specification. The property addressed by Morita is solely related to the amount of solvent retained by the thermoplastic polymer layer and does not consider other substances that make up the "residual volatile component" as defined in the present specification.

Unexpected and Superior Results of the Present Invention

Applicants previously submitted for the Examiner the Declaration by Takashi Masuko (hereafter the "First Masuko Declaration"), dated March 5, 2002, filed in accordance with 37 C.F.R. 1.132. The Examiner stated many objections to the First Masuko Declaration to include (a) the declaration did not refer to the individual claims (October 14th Office Action, page 18, lines 17-20), and (b) the comparative evidence did not compare the claimed invention to the closest prior art of Morita (October 14th Office Action, page 21, lines 8-2012).

The Comparative Evidence is Commensurate in Scope with the Claims

Courts have held that evidence of non-obviousness must be commensurate in scope with the claims. Burlington Industries v. Quigg, 3 U.S.P.Q.2d 1436, 1438 (Fed. Cir. 1987). The Examiner's opinion appears to be that the Declaration must be commensurate in scope

with the claims, and that a declaration that does not discuss the claims will not be considered (October 14th Declaration, page 18, lines 17-20). Applicants believe that the Rules of Practice in Patent and Trademark Cases (37 C.F.R.) and the common law are the rules that properly apply to Applicants. There is no rule in 37 C.F.R. or in the common law that requires a declaration refer specifically to the claims.

Be that as it may, Applicants submit a revised Declaration by Takashi Masuko (hereafter the "Second Masuko Declaration"), executed in April 2004, and filed herewith in accordance with 37 C.F.R. 1.132. The Second Masuko Declaration establishes that when the novel film (see Section 7 on page 4) made in accordance with the present invention is compared to the closest prior art film (see Section 6 on page 3) disclosed by Morita et al. under identical experimental conditions, the result is that the novel film of the present invention demonstrates an "**unexpected superiority**" (page 7, lines 13-23). As shown in Table 2 on page 6 of the Second Masuko Declaration, when evaluating the two films for the occurrence of reflow cracks it was shown that while **all** of the Morita film samples under the given die-bonding conditions manifested reflow cracks, **none** of the samples made in accordance with the present invention had reflow cracks.

Example 1 of Morita is the Closest Prior Art

Courts have long held that an applicant relying on a comparative showing to establish secondary evidence of non-obviousness must compare the claimed invention to the closest prior art. In re Merchant, 197 USPQ 785, 788 (CCPA 1978). However, an indirect comparison between the claimed invention and the closest prior art may be acceptable in some circumstances. In re Fouche, 169 U.S.P.Q. 429, 433 (C.C.P.A. 1971).

In this case, Applicants have compared the claimed invention (See Section 7 of the Second Masuko Declaration) to Morita's prior art film described as Example 1 (See Section 6

of the Second Masuko Declaration). The Examiner argues that the prior art film of Example 1 of the Morita reference is not the closest prior art and asserts that Embodiment No. 13, compiled in Table 1 of Morita, is the closest prior art (October 14th Office Action, page 21, lines 8-12). Applicants disagree with the Examiner's conclusion for the following reasons.

While Applicants note that Morita's Embodiment No. 13 has the highest peel strength (i.e., 67 g/(10 mm x 10 mm chip)) of all of Morita's embodiments, the bonding temperature is 350°C, which is significantly higher than the bonding temperature of 100-250°C recited in claims 17, 19, 30, 51, 58 and 64 of the present invention. On the other hand, the bonding temperature for Embodiments Nos. 1-6, which utilize the film of Example 1 (See Table 1 of Morita), are as low as 270°C. Therefore, Applicants previously reasoned that a Morita embodiment using a film from Example 1 would be closer to the present invention than Embodiment No. 13 because bonding conditions are expected to dramatically influence the resulting peel strength of the adhesive bond.

Applicants still believe that the closest prior art of Morita is the film made in accordance with Example 1 of Morita (See Section 6 of the Masuko Declaration) because the bonding conditions of Morita's Embodiments using this film have bonding conditions that most closely resemble those of the presently claimed invention. Applicants expect that the 67 g/(10mm x 10mm chip) peel strength reported in Table 1 of Morita for Embodiment No. 13 will not be realized when tested under the bonding conditions of the present invention.

Furthermore, Mr. Masuko opined that he believed, in view of his experience in the art, that Embodiments Nos. 1 through 24 compiled in Table 1 of Morita would manifest similar areal peel strengths because the examples exhibit only minor differences in the structure of the original materials, the acid anhydride, and the diamine, used to make them (Second Masuko Declaration, page 3, lines 16-22). So, an indirect comparison made to the film made

in accordance with the presently claimed invention would still weigh in favor of patentability over Embodiment No. 13 of Morita for the following reason.

Embodiment No. 13 of Morita had peel strength that was about 3 times stronger than achieved by films made in accordance with Morita's Example 1 (See Table 1 of Morita). If the values for peel strength of Morita's film peel strength, compiled in Table 1 of the Second Masuko Declaration, were multiplied by a factor of 3, these peel strength values would still be significantly and unexpectedly overwhelmed by the strength of the Novel film.

In summary, Applicants believe that they have compared the present invention to the closest prior art of Morita. Even though Embodiment No. 13 of Morita has the highest peel strength when bonded at 350°C, it is unlikely that a film made in accordance with Embodiment No. 13 would attain such values when die bonded at only 250°C in accordance with the die bonding conditions and definition of peel strength of the presently claimed invention. In the alternative, should Embodiment No. 13 of Morita be properly construable as the closest prior art embodiment (a point Applicants do not concede) Applicants have indirectly established that the presently claimed invention would still be unexpectedly superior.

The courts have held that there is no requirement for the unexpected results relied upon for patentability to be recited in the claims so long as the features responsible for the unexpected results are recited in the claims. In re Merchant, 197 USPQ 785, 788 (CCPA 1978). In the present case, the properties of the film are the "features" of the film responsible for the unexpected results. Specifically, the organic die-bonding film made in accordance with the present invention must have the property of bonding under the conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2, and must comprise an organic material that includes epoxy resin and polyimide resin as recited in independent claims 51, 58 and 64. While claims 17, 19 and 30 define an invention of different scope than claims 51, 58 and 64,

claims 17, 19 and 30 do define inventions having a scope that includes a die bonding film having epoxy resin and polyimide resin.

In addition, when peel strength was measured (Second Masuko Declaration, section 8) the peel strength, as defined by Figure 2 and page 33, lines 1-16 of the present application, was significantly greater for the novel film of the present invention over the Morita film (see Table 1 on page 5 of the Second Masuko Declaration). In fact, when the die-bonding condition was set as "250°C x 30gf/mm^2 x 20 sec," as in claims 17, 19, 30, 51, 58 and 64, all of the chips made using the novel film were destroyed during testing because the bond strength was stronger than the chip. In other words, the bond strength of the material in accordance with the present invention was stronger than what this particular test could measure! Clearly, this is another superior and unexpected result.

Applicants do not agree that the Examiner has properly established a prima facie case of obviousness given the arguments previously presented. In view of the Second Masuko Declaration, however, even if there were a proper prima facie case of obviousness standing against claims 17, 19, 30, 51, 58 and 64, it has been sufficiently rebutted and overcome by the factual results wherein the organic die-bonding film of the present invention manifests unexpected invulnerability to reflow cracking. Furthermore, when the property of peel strength as defined by the present application is considered, any prima facie case of obviousness standing against claims 17, 30, 51 and 64 is additionally rebutted. In these claims, the material includes the property of "a peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher," as defined by the present specification, which is not attainable by the comparison prior art film material made in accordance with the teachings of the Morita et al. reference.

Summary of Unexpected Results

The Second Masuko Declaration is commensurate in scope with independent claims 17, 19, 30, 51, 58 and 64 of the present application, and the Second Masuko Declaration specifically addresses this issue in Section 9. The Second Masuko Declaration compares the present invention, represented by the embodiment described in Section 7 of the Second Masuko Declaration, to the closest prior art of Morita, which is Example 1 (See Section 6 of the Second Masuko Declaration). Applicants assert that Example 1 of Morita represents the closest prior art because the bonding conditions compiled for Embodiments Nos. 1-6 in the Table of Morita are closer to those recited in claims 17, 19, 30, 51, 58 and 64 than the bonding conditions taught for Morita's Embodiment No. 13. Lastly, Applicants assert that the significantly superior peel strength (as defined by the present specification) and the absence of reflow cracks for the organic die bonding film made in accordance with the present invention was unexpectedly superior to the prior art film of Morita.

For all of the reasons argued above, Applicants assert that the comparative testing submitted in the Second Masuko Declaration is sufficient to overcome any prima facie obviousness rejection in view of the Morita et al. reference.

Applicants incorporate herein the arguments made previously in Amendment (B) filed June 19, 2002, and in Supplemental Response to Amendment (B) filed October 16, 2002, and in Amendment (C), filed June 30, 2003.

Examiner's Request for Information under 37 C.F.R. § 1.105

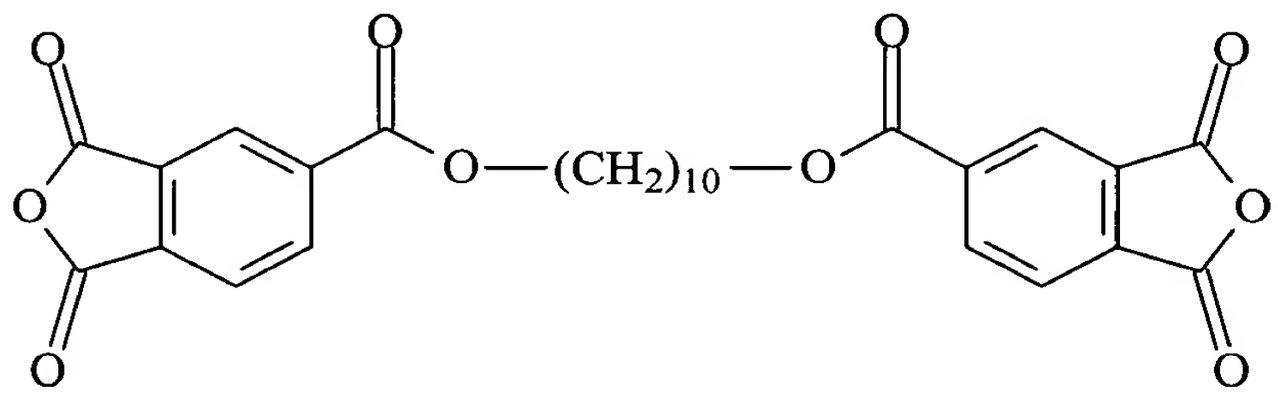
The Examiner requests for additional information regarding the compound 1, 10-(decamethylene)bis(trimellitate anhydride) as follows: (a) confirmation that the nomenclature of the compound is correct; (b) list of synonyms and keywords that may facilitate a search; (c) title, citation and a copy of each publication that Applicants relied upon

to develop the disclosed subject matter or relied upon to draft claims 43 and 44; (d) a concise explanation of the reliance placed on such publications listed in (c); and (e) state whether a search was performed and the scope of the search (Office Action, dated October 14, 2003, page 22, lines20-23, and Examiner's Attachment page 2, line 1, to page 3, line 22).

Applicants respond with candor and in good faith in accordance with 37 C.F.R. § 1.56 as follows.

The nomenclature regarding the compound 1, 10- (decamethylene)bis(trimellitate anhydride) is correct. This compound may be abbreviated as "DBTA." The compound is recorded as decamethylene-bis(trimellitate) anhydride in CAS (CAS No. 123046-43-5). The chemical structure is as follows.

DBTA



As discernable from the above structural formula, this compound can also be referred to as "1, 10-decamethyleneglycol-bis(trimellitate anhydride)" because it is an ester of decaethylene glycol and trimerit acid. However, it is also acceptable to refer to the compound having the above structural formula as 1, 10- (decamethylene)bis(trimellitate anhydride) without being in error. For example, as an ester ($CH_3COOC_2H_5$) of acetic acid and ethanol may be called "ethyl acetate" because it is generally accepted to name esters based on the alkyl group instead of based on the name of the alcohol. The Examiner is referred to IUPAC naming methods as well. Functional class nomenclature is another conventional naming method as is Radicofunctional nomenclature.

As explained above, the DBTA compound is a general compound recorded in the CAS, a copy of which is included with the attached Information Disclosure Statement. The DBTA compound is mentioned in col. 7, lines 8-9, of U.S. Patent 6,046,072 to Matsuura et al., which was previously submitted as "Document AG" in the Information Disclosure Statement, filed July 7, 2003, of the present prosecution.

Applicants point out that "EBTA" is a compound similar to DBTA, and is mentioned in Japanese Publication Laid-Open (Kokai) 5-105850, a copy of which is included with the attached Information Disclosure Statement. Applicants believe that a search for EBTA may also reveal references that mention DBTA.

Any additional information requested by the Examiner in the Examiner's Attachment to the October 14th Office Action is either unknown or cannot be readily obtained by the Applicants or the Applicants' assignee.

Conclusion

Claims 17-19, 21-34 and 37-64 are now in compliance with 35 U.S.C. 112. The rejection of claims 17, 19 and 30 under 35 U.S.C. § 103(a) over the Morita reference is untenable and should be withdrawn because all of the claimed limitations are neither disclosed nor suggested by the reference. Specifically, Morita does not teach or suggest the following: (a) the bonding "conditions of 100-250°C temperature and pressure of 0.1-30 gf/mm^2" recited in claims 17, 19 and 30; (b) "peel strength of 0.5 kgf/(5 mm x 5 mm chip) or higher" recited in claim 17 and 30, where the meaning of "peel strength" is defined by Figure 2 and page 33, lines 1-16 of the present application; or (c) "saturation moisture absorption of 1.0% by volume or less" recited in claims 18, 26, and 28-30. Claims 51-64 are separately patentable because they define a narrower organic material limitation not taught or suggested in the prior art.

Morita et al. also fail to teach, or even suggest, the "organic die-bonding single layer film" having the features recited in claim 19. Furthermore, Applicants have shown that the combination of the Berger reference and the Morita et al. reference is untenable and should be withdrawn because Berger does not actually teach a polyimide synthesized from 4, 4'-diaminodiphenyl ether and 1, 2-(ethylene)bis(trimellitate anhydride) so there is no reasonable suggestion revealed by these references to make the claimed organic die bonding film recited in claim 40. Lastly, the Examiner has improperly construed the limitation of "a void volume of 10% or less in terms of voids present in the material," as recited in claim 30, as a result effective variable when, in fact, it is a property of the film. Consequently, the Examiner has misapplied caselaw directed to result effective variables against the present claims.

Furthermore, Applicants have shown, by the comparative testing submitted in the Second Masuko Declaration, that the organic die-bonding film of the present invention manifests superior and unexpected results, including an invulnerability to reflow cracking and a markedly improved peel strength (as defined by Figure 2 and page 33, lines 1-16, of the above-captioned application) over the material disclosed by the prior art films. Consequently, the results of comparative testing compiled in the Second Masuko Declaration would sufficiently rebut any potential prima facie case of obviousness established in view of the Morita reference.

For all of the above reasons, claims 17-19, 21-34 and 39-64 are in condition for allowance, and prompt notice of allowance is earnestly solicited. Questions are welcomed by the below-signed attorney for applicants.

Respectfully submitted,
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